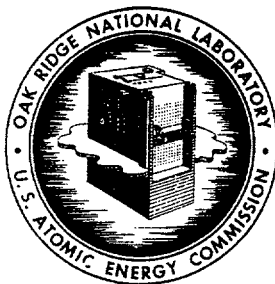


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1437

HEALTH PHYSICS DIVISION

APPLIED HEALTH PHYSICS QUARTERLY REPORT -
JULY, AUGUST, AND SEPTEMBER OF 1962

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TABLE OF CONTENTS

	<u>Page</u>
1.0 SUMMARY.....	4
2.0 UNUSUAL OCCURRENCES.....	4
3.0 PERSONNEL MONITORING.....	11
3.1 External Dose Measurements.....	11
3.2 Internal Dose Measurements.....	11
4.0 ENVIRONMENTAL MONITORING.....	12
4.1 Air-borne Radioparticulate Measurements.....	12
4.2 Fall-Out Measurements.....	12
4.3 Water Analysis.....	12
4.4 Background Measurements of Ionizing Radiation.....	13
5.0 TABLES (Titles and Page Numbers).....	14
6.0 FIGURES (Titles and Page Numbers).....	23

1.0 SUMMARY

1.1 Unusual Occurrences - There were 16 unusual occurrences recorded during the third quarter period. (The number for the first and second quarters of 1962 was 20 and 14 respectively; the quarterly average for 1961 was 20.)

1.2 Personnel Exposures - There were 13 exposures which equalled or exceeded $1/3$ of a maximum permissible quarterly dose. In one case both the skin dose (D_S) and critical organ dose (D_C) were involved. In the remaining 12 cases only the critical organ dose was involved. In no case did an exposure exceed 50% of the maximum permissible quarterly dose. Ten cases involved personnel assigned to the Isotopes Division; one case each involved the Chemical Technology, Health Physics, and Inspection Engineering Divisions.

1.3 Air-Borne Radioparticulate Measurements - Air-borne radioparticulate matter collected by the LAM network in the Laboratory area averaged 2.6×10^{-12} $\mu\text{c/cc}$ during the quarter; the average value determined from the data generated by the PAM network was 2.4×10^{-12} $\mu\text{c/cc}$; the value for the RAM network was 2.9×10^{-12} $\mu\text{c/cc}$. The above values indicate that Laboratory operations did not contribute significantly to air contamination levels recorded in the East Tennessee area during the third quarter of 1962.

1.4 Water Monitoring - Clinch River water taken from the ORGDP water intake (CRM 14.5) averaged 5.7% of $(\text{MPC})_w$ for the neighborhood of an atomic energy installation. The average recorded during the second quarter of 1962 was 12.4% of $(\text{MPC})_w$.

1.5 Background Radiation - 0.118 mr/hr average at ORNL and 0.028 mr/hr average off-site. (The corresponding values for the second quarter of 1962 were 0.096 and 0.030 mr/hr respectively; the value recorded at the ORNL site in the year 1943 was approximately 0.012 mr/hr.)

2.0 UNUSUAL OCCURRENCES

There were 16 unusual occurrences recorded¹ during the third quarter period. Two of these events (5 and 12) involved cuts on the hands where contamination by injection did not materialize although the potential for contamination was present; two events (1 and 4) presented a high exposure potential when (a) a source used for radiography was ejected from its shield and (b) a slug of radioactive materials migrated outside a shielded cell; operating facilities were contaminated following two

¹The method for classifying unusual occurrences is described in ORNL-3073, pp. 4-5.

events (3 and 13) when malfunctions arose in parts of the operating equipment; the contamination of personnel and facilities was involved in eight events (2, 6, 7, 8, 9, 11, 14, and 15) when equipment failed and/or operating procedures were not effective; one event (10) involved an employee who became contaminated while cutting grass; and an isotope shipment was found (16) on the streets of Oak Ridge after having been turned over to a Knoxville transport service.

1. An employee received a critical organ dose (D_c) of approximately 970 mrem when an 11-curie source of iridium-192 was moved prematurely from its shielded position. A second employee who assisted in the operation received a D_c of approximately 70 mrem.

The incident occurred while the two employees were setting up radiography equipment to be used for checking welded joints contained in a newly installed piping system. Ordinarily, the iridium-192 source is contained in its shield until all parts of the radiographic systems are in place. Then, when required and with personnel at a safe distance, the source is caused to move from the shield through a transfer tube to its final position where it remains during the irradiation process. In this particular instance, the shield containing the source had been positioned and the manipulator control cable and transfer tube had been attached. The operators then turned to other tasks and about ten minutes later, while performing a routine radiation survey, discovered that the source had moved out of its shield and was positioned about one foot away from the shield at a position in the transfer tube. The operation was halted immediately, the source returned to its shield, and steps taken to determine the exposure status of the persons involved.

The above incident resulted from a malfunction which developed in the apparatus and the exposure conditions were unknown to the operators up until the time that radiation measurements were made. The incident points up the desirability of developing operating procedures which provide for the routine monitoring of radiation source material when the quantity or type of material is such as to lead to significant consequences when failures occur.

2. A portion of the penthouse area of Bldg. 3019 became contaminated as the result of air-borne radioactivity which occurred during a decontamination operation involving VPP process equipment. One of the four employees involved in the operation showed traces of nasal contamination but no significant internal exposure resulted as indicated by urinalysis and whole body counting techniques.

The decontamination operation involved the loading of a vessel with a non-radioactive salt. Ordinarily, the vessel was maintained at a negative pressure and smoke tests had confirmed that a negative pressure existed at the time that the operation was started. About half of the salt had been deposited in the vessel when an alarm signal sounded at a continuous air monitor (CAM) located about eight feet away from the work area. The operators assumed that a positive pressure had developed, lead-

ing to a release of radioactive contaminants, and effected an immediate withdrawal of personnel from the penthouse area. Subsequent tests indicated that the charging operation was such as to create a temporary buildup of pressure sufficient to breach a friction-seal corporate to the system. A positive seal was provided and the operation successfully completed a day later.

As the operation was non-routine, and would not be repeated, no additional modifications were contemplated in the equipment.

3. A small section of the floor in the pipe chase and Lab 3, Bldg. 3508, became contaminated when approximately two gallons of waste solution containing Am-241 and Cm-242 leaked from a hot waste line. (The leak was discovered by technicians working in Lab 3.) Direct readings as high as 10^4 d/m/100 cm² (α) were obtained from the contaminated floor surface, and smear results indicated transferable contamination up to 500 d/m per 100 cm² (α). After repeated decontamination efforts which were not too effective, portions of the floor were chipped out and replaced. A few days later a second leak was discovered in the same hot waste line. An inspection indicated that the pipe had been affected by the corrosive action of acids. The problem was corrected by welding a new section of pipe in place.

No personnel contamination was involved, and air samples indicated no air activity was present on either occasion.

4. Operations were delayed in Bldg. 4507 for approximately 12 hours following the migration of a "slug" of radioactive materials through an instrument line to a point in the penthouse area located just above a shielded cell. No air-borne radioactivity resulted as the containment system was not breached; personnel exposures were held to 40 mrem or less.

Operating personnel became aware of an abnormally high radiation background when two radiation-sensing devices, each located in separate work areas, actuated alarms in the control room. (The building was not placed automatically in "containment status" as only one alarm sounded in each area.) Operations were halted immediately and steps taken to evaluate the cause of the two alarms. Preliminary surveys eventually led to the penthouse area where the radiation source was determined to be associated with an array of piping that extended through the roof of the cell. Subsequent tests narrowed the radiation source to three particular pneumatic instrument lines where readings up to 200 rad/hr were measured; shortly thereafter, the contents of the three lines were flushed back down into the cell and the radiation background returned to normal almost immediately.

It was determined that the incident resulted from the over-pressuring of a resin column located in the cell. Instrumentation was available which ordinarily warned control room personnel of excessive pressure in the system in time to effect measures to prevent solution from rising out

of the cell via the instrument line. However, accurate readings are afforded by the instrument only when the density of the solution being handled is taken into consideration. In this case, the density of the solution being handled was different from the density of solutions encountered in previous runs. Consequently, indications of the over-pressure were not acknowledged nor acted on in time to prevent the solution from rising out of the cell via the instrument line.

Action taken by supervision to prevent a recurrence: (1) operating personnel were instructed relative to precise techniques in using the pressure drop indicator during resin removal, (2) the procedure was reviewed and additional safeguards considered, (3) run sheets are being revised to incorporate additional safeguards, and (4) a check-valve will be placed in the pressure drop instrument line to prevent solution from leaving the cell via the instrument line.

5. A subcontractor employee sustained cuts to his right hand while painting in a contaminated area located in Bldg. 3019. The injury resulted when a steel beam became dislodged, fell a short distance, and came in contact with the hand of the employee. The health physics survey indicated no radioactive contamination in or near the wound. Likewise, no contamination was found on the steel beam. Urinalysis data were negative.

6. The first floor area at Bldg. 4507, the street connecting Bldg. 4507 with Bldg. 4505, and certain areas within Bldg. 4505 were contaminated with ruthenium-106 by tracking when two workmen left a construction area in Bldg. 4507 unaware that a contamination potential existed. (Ordinarily, traffic to and from Bldg. 4507 is regulated through a common entrance where hand and foot counts are performed routinely upon exiting. However, during these particular construction activities, this regulation had been suspended temporarily in view of an assumed contamination-free status of the facility.) Urinalysis and whole body counting techniques indicated that no internal exposures were incurred.

The contamination incident came to light when two employees performed a routine hand and foot count in Bldg. 4507 and discovered that their shoes were contaminated. Radiation surveys were initiated immediately and the source of contamination traced to the general area in and around Cell 4 at Bldg. 4507 where new construction work was in progress. Upon investigation it was learned that two workmen had removed, then replaced, a plug from a hot drain stub in Cell 4 where a new section of pipe was to be welded. After the plug had been replaced, the workmen left the building, passed through the change room of Bldg. 4505, and then proceeded to a small shop located in Bldg. 4505. Surveys initiated along the route taken by the two workmen showed the following areas to be contaminated: (1) spots on the street south of Bldg. 4505 leading to Bldg. 4507, (2) Room 14, Bldg. 4505, (3) the change room in Bldg. 4505, (4) the west hallway of Bldg. 4505, (5) the small shop in the southeast corner of Bldg. 4505, and (6) the maintenance office in Bldg. 4505.

The above incident would not have occurred had continuing surveillance been maintained during construction activities—a procedure which should be followed where the facility has had a contamination history. The cell area had been decontaminated prior to the beginning of construction work and during the course of the work the plug in the hot drain had been removed several times with no trace of contamination being observed. Of importance, however, was the fact that the drain line from which the plug was removed was still connected with other hot cells. Had the drain line been treated as a potential contamination source since it was connected to the rest of the system, surveys would have been initiated each time the plug was removed with the result that the incident could have been avoided.

Supervision over the area has taken the following steps to avoid a recurrence of this type of incident: (1) no cell work at any time will be started on a day-to-day basis without the execution of a (local) Hazards Work Permit and a (general) certified Radiation Work Permit, (2) the regular building regulations will remain in effect with only one entrance and exit where hand and foot checks will be effected as a requirement for exiting, and (3) the work area behind the cells will be designated as a Contamination Zone with work requirements specified.

7. Personnel using a hood in a chemical laboratory in Bldg. 4500-S were contaminated slightly when the hood exhaust failed to carry off radioactive vapors during an operation involving the evaporation of a solution containing sodium-24. Four employees were involved with personnel contamination limited mainly to the shoes as the contaminant was generally confined to the floor areas. Although traces of nasal contamination were detected in the case of two employees, urinalysis and whole body counting techniques indicated no significant internal exposures.

Pressure drop tests confirmed that the hood filters had clogged to a point that the air flow in the hood was inadequate. Steps have been taken wherein air flow checks and filter changes in this area will be effected on a more frequent schedule.

8. Three employees were contaminated over the nape of the neck and each of them inhaled small quantities of alpha activity (as shown by nasal smears) following maintenance operations involving a fission product waste catch tank in Bldg. 3019. The contamination was removed easily by showering and irrigation of the nostrils. Urine and fecal analysis indicated that no significant internal exposure resulted.

A question as to proper equipment and clothing handling technique surrounds the above incident. All three employees were garbed in the same manner. Each wore inner garments consisting of coveralls, gloves, and shoes over which were placed shoe covers. Over the inner garments each wore a second pair of coveralls, a second pair of gloves taped at the sleeves, and a second pair of shoe covers taped at the ankles. Cloth hoods were worn covering the neck and top of the head. In addition, each individual was fitted with an assault mask. As is customary in a fitting

of the above type, copious amounts of masking tape were used to seal button-down flaps which might otherwise permit contamination to enter so that no portion of the body need be exposed. Consequently, if skin surfaces become contaminated, or if the person is subjected to air-borne contaminants, such usually occurs (1) during removal of the equipment, or (2) where the contaminant is of a type that will penetrate the clothing or the filter of the assault mask. The latter was not likely in the above case; therefore, one suspects that improper techniques were used during the removal of the garments and the assault masks.

In the future, where large amounts of contamination are likely to be encountered, plastic suits fitted with a positive air supply will be used. In all cases emphasis will be placed upon the proper techniques.

9. A routine hand and foot check led to the discovery of thallium-204 contamination in Bldg. 3038 and the change room in Bldg. 3037. Although some minor personnel contamination occurred, no significant internal exposures resulted from this incident.

The contamination probably resulted from the following sequence of events. First, the contents of a bottle containing thallium were spewed on the floor of the barricaded area in the southeast corner of the building. The solution evaporated leaving a dry residue of thallium. Second, an operator opened the pipette door to the barricade while a large pedestal fan was blowing in the direction of the door. Thus, the dry thallium was blown from the barricade floor and settled on the main floor of the shipping area and other horizontal surfaces.

As a result of this occurrence, the use of the pedestal fan has been discontinued.

10. An employee's shoes and trouser legs became grossly contaminated while he was cutting grass with a power lawn mower in the south tank farm. The source of contamination was confined to a grassy spot which embraced an area of about one square foot and probed up to 4 rad/hr. The contamination on the employee was limited to the area below the knees and no significant internal exposure resulted. Tank farm supervision has stepped up routine surveillance over the area with more careful control over access to the area by non-operating personnel.

11. Two workmen and the work area where they were assigned became contaminated while maintenance was being performed atop the iodine-131 cell in Bldg. 3028-W after a line had been cut which led from a dissolver in the iodine cell. Decontamination procedures were put into effect promptly and neither of the two individuals received a significant internal exposure.

12. An employee was performing decontamination operations on a set of manipulator tongs at Bldg. 3025 when a sharp object penetrated the rubber glove worn on his right hand cutting the right forefinger at the first joint. The employee removed the gloves immediately, washed his hands, and reported to the dispensary. No contamination was found near the

wound or on the wounded finger. However, contamination (which probably resulted during the removal of the gloves) was found on both thumbs and on the middle finger of the left hand. No significant internal exposure resulted from the incident.

13. The wall, feed pump, and the floor behind the sample panel board at Bldg. 4507 became contaminated when approximately 50 ml of solution containing volatile ruthenium escaped from a broken capillary vacuum tube. The capillary tube constituted a part of the sampling system. Although extensive decontamination procedures were necessary, no personnel exposures resulted from the incident.

14. An employee breathed a quantity of iodine-131 following an iodine vapor release in Bldg. 3032. Whole body counting techniques indicated that the initial thyroid burden following the incident was approximately 0.24 μ c. The exposure to the thyroid was about 1.6 rem which represents 16% of the maximum permissible quarterly dose for the thyroid.

The operation which led to the iodine release involved the decontamination of ampoule loading equipment located inside a hood. The employee was using cotton pads saturated with an organic solvent to decontaminate the equipment when an alarm sounded at a continuous air monitor nearby. The operation was stopped, surveys initiated, and the employee found to be contaminated.

Investigation indicated that the incident resulted from the improper disposal of the solvent-laden cotton pads. As a result, the procedures used in this particular operation have been reviewed and steps taken to provide for pad disposal in such a manner as to eliminate the possibility of contamination arising from this type of operation.

15. An employee was subjected to iodine-131 vapors during an operation involving disposal of the waste portion of a number of product samples which were being released to a temporary hot drain located in the analytical laboratory at Bldg. 3038. Whole body counting techniques indicated that the deposition of iodine-131 in the thyroid reached approximately 0.13 μ c. The total thyroid dose was approximately 0.9 rem which represents 9% of the maximum permissible quarterly dose for the thyroid.

Prior to this incident, lesser quantities of iodine solutions had been involved in releases to the hot drain noted above. On this particular occasion, more than the usual amount of iodine was being released. In addition, it was believed that some of the waste material may have come in contact with acid reagents in the drain lines; thus, volatilization occurred with a subsequent buildup in pressure, which led to the release of iodine to the room atmosphere.

In future operations of the above type, releases will be limited to quantities of iodine-131 of less than 1 millicurie and hot drains will be used that are vented properly.

16. Two ORINS employees happened to be passing the intersection of Illinois Avenue and Lafayette Drive in Oak Ridge when they noticed a shipping carton lying in the street. They examined the carton, observed from the labels that it was a shipment of radioisotopes, and decided to take it to the health physicist at ORINS. The health physicist monitored the two men and the container and found no contamination; readings up to 160 mrad/hr were observed at the outer surface of the container.

The shipment, containing approximately 1.325 curies of iodine-131, had left ORNL via a Knoxville commercial transport service vehicle about 30 minutes before it was discovered on the street in Oak Ridge. Following notification that the shipment had been found and had been taken to ORINS, ORNL representatives returned it to the Laboratory where it was inspected and found to be in satisfactory condition.

Despite the obvious mishandling of this shipment by the transport company, there was no release of contamination and no significant external exposure to personnel. This is perhaps fortunate in view of the potentialities presented by the incident.

3.0 PERSONNEL MONITORING

3.1 External Dose Measurements - The highest whole body exposure recorded during the third quarter (see Table 5.1) was 1.5 rem, which represents 50% of the maximum permissible quarterly dose (MPD)_Q. The second highest exposure recorded in this category was 47% of the (MPD)_Q or about 1.4 rem. The highest whole body skin dose recorded during the quarter was 3.9 rem which is 39% of the (MPD)_Q² for this type of exposure. The second highest whole body skin dose was 3.3 rem or 33% of the (MPD)_Q.

3.2 Internal Dose Measurements - During the third quarter one employee submitted several urine specimens which tend to indicate that a significant fraction of a permissible body burden involving transuranic alpha emitters has been sustained. Continued surveillance should lead to an assessment of the magnitude and significance of the exposure during the fourth quarter.

Three employees continued to have an estimated bone burden of approximately 1/3 of the maximum permissible body burden for Pu-239.³

²The (MPD)_Q established by the FRC for the skin of the whole body is 10 rem.

³Action is taken to curtail an employee's exposure to internal emitters when measurements approach 30 per cent of a body burden.

4.0 ENVIRONMENTAL MONITORING

4.1 Air-Borne Radioparticulate Measurements - The average concentrations of radioactive materials in air sampled by the three ORNL air monitoring networks⁴ are given in Table 5.2. The quarterly average for the LAM network was 2.6×10^{-12} $\mu\text{c/cc}$; averages for the PAM and RAM networks were 2.4×10^{-12} $\mu\text{c/cc}$ and 2.9×10^{-12} $\mu\text{c/cc}$ respectively. The above values are approximately 40% less than those observed during the second quarter but are about 50 times greater than the average concentrations recorded just prior to the resumption of weapons testing in September of 1961. (A 12-month comparison is shown in Fig. 6.1.)

4.2 Fall-Out Measurements - Radioparticulate fall-out measurements by the gummed paper technique⁵ indicated that fall-out during the third quarter increased over the second quarter by a factor of 1.7. One observes from Fig. 6.2 a general decline in particulate fall-out through the second quarter of 1962 beginning with a peak level which occurred in November of 1961 just following the resumption of weapons testing in the eastern hemisphere.

It is an accepted fact that fall-out is influenced locally by meteorological conditions and there will be noticeable variations from week to week. However, over a period of several weeks, trends will be observed and the increase during the third quarter is no doubt due to weapons testing which began during 1962. Variations in weekly measurements made during the third quarter are shown in Table 5.3. The consistency between network averages shown in Table 5.3 indicates that the fall-out material is not of local origin.

4.3 Water Analysis

Rain Water - The quarterly average concentrations of radioactive materials deposited in rain water collected by the LAM, PAM, and RAM networks were 0.8×10^{-6} $\mu\text{c/ml}$, 0.7×10^{-6} $\mu\text{c/ml}$, and 0.6×10^{-6} $\mu\text{c/ml}$ respectively. These values are somewhat less than those reported for the first and second quarters of 1962. Average concentrations recorded for each collection station are given in Table 5.4. A comparison between values recorded during the first three quarters of 1962 and the years 1959, 1960 and 1961 is shown in Fig. 6.3.

Clinch River Water - Approximately 183 beta curies of radioactivity were discharged via White Oak Creek into the Clinch River during the

⁴LAM - Local Air Monitor (located at or near the ORNL site); PAM - Perimeter Air Monitor (located on the outer boundary of the AEC controlled area); RAM - Remote Air Monitor (located from 12 to 75 miles from ORNL).

⁵The gummed paper collector presents a collection surface of 1 square foot. Particles per square foot are determined by autoradiography.

third quarter of 1962. The isotopic distribution of radionuclides in the White Oak Creek effluent is given separately for the months of July, August and September in Table 5.5.

Assuming uniform mixing of White Oak Creek with Clinch River waters at the juncture of the two streams (CRM 20.8), the calculated monthly average gross beta concentration in the Clinch River following dilution was as follows:

<u>Month</u>	<u>Concentration</u>
July	$0.29 \times 10^{-6} \mu\text{c/ml}$
August	$0.04 \times 10^{-6} \mu\text{c/ml}$
September	$0.24 \times 10^{-6} \mu\text{c/ml}$

The above values, taken from Table 5.6, represent 6.3, 1.9 and 5.4 per cent of the maximum permissible concentration, $(\text{MPC})_w$, applicable to individuals living in the neighborhood of an atomic energy installation. The average for the third quarter was 4.5 per cent of the $(\text{MPC})_w$.

The average concentration of radioactive materials in Clinch River water sampled at the ORGDP water filtration plant intake (CRM 14.5) was as follows:

<u>Month</u>	<u>Concentration</u>
July	$0.26 \times 10^{-6} \mu\text{c/ml}$
August	$0.05 \times 10^{-6} \mu\text{c/ml}$
September	$0.09 \times 10^{-6} \mu\text{c/ml}$

As shown in Table 5.7, the above values represent 9.3, 4.0 and 3.8 per cent of the $(\text{MPC})_w$ for the specific mixture of radionuclides present. The average for the quarter was 5.7 per cent of the $(\text{MPC})_w$.

There appears to be good correlation between the calculated $(\text{MPC})_w$ for Clinch River water at CRM 20.8 (Fig. 6.4) and the measured $(\text{MPC})_w$ for Clinch River water at CRM 14.5. (The data shown in Fig. 6.4 cover the 12-months period ending with September of 1962.)

4.4 Background Measurements of Ionizing Radiation - The average background level for 53 stations located on the Laboratory site was 0.118 mr per hour. The average level for five stations located off-site around the perimeter of the controlled area was 0.028 mr/hr. From Table 5.8 it is observed that background levels at ORNL were about 10 times those recorded in 1943 prior to the startup of the graphite reactor; the background off-site was about twice the 1943 value. The average for the first three quarters of 1962 differs only slightly (Fig. 6.5) from averages recorded during 1959, 1960 and 1961.

5.0 TABLES

	<u>Page</u>
5.1 Personnel Monitoring Exposure Resume—3rd Quarter, 1962.....	15
5.2 Concentration of Radioactive Materials in Air Averaged Weekly from Filter Paper Data—3rd Quarter, 1962.....	16
5.3 Radioparticulate Fall-Out Measurements Averaged Weekly from Gummed Paper Data—3rd Quarter, 1962.....	17
5.4 Concentration of Radioactive Materials in Rain Water Averaged for the Quarter by Stations—3rd Quarter, 1962.....	18
5.5 Radionuclides in White Oak Lake Effluent—3rd Quarter, 1962....	19
5.6 Average Concentration of Radioactive Materials in the Clinch River at Mile 20.8—3rd Quarter, 1962.....	20
5.7 Average Concentration of Radioactive Materials in Clinch River Water at ORGDP Filtration Plant Intake—3rd Quarter, 1962.....	21
5.8 Background Measurements of Ionizing Radiation—3rd Quarter, 1962.....	22

Table 5.1 Personnel Monitoring Exposure Resume—3rd Quarter, 1962

Employee	Division	Third Quarter Dose (rem)			Cumulative Dose for 1962 (rem)		
		D _s	D _c	% MPD _Q	D _s	D _c	% MPD _A
A	Isotopes	3.3	<u>1.5</u>	50	4.7	<u>2.3</u>	19
B	Health Physics	3.9	<u>1.5</u>	50	7.4	<u>3.0</u>	25
C	Isotopes	2.2	<u>1.4</u>	47	4.0	<u>2.5</u>	21
D	Isotopes	2.1	<u>1.4</u>	47	5.0	<u>3.7</u>	31
E	Isotopes	2.3	<u>1.2</u>	40	3.8	<u>2.1</u>	18
F	Isotopes	2.2	<u>1.1</u>	37	3.9	<u>1.9</u>	16
G	Isotopes	1.4	<u>1.1</u>	37	2.5	<u>2.2</u>	18
H	Isotopes	1.7	<u>1.1</u>	37	3.5	<u>2.5</u>	21
I	Chem. Tech.	1.2	<u>1.1</u>	37	3.4	<u>3.0</u>	25
J	Insp. Engr.	2.1	<u>1.0</u>	33	2.6	<u>1.4</u>	12
K	Isotopes	1.9	<u>1.0</u>	33	2.8	<u>1.2</u>	10
L	Isotopes	1.4	<u>1.0</u>	33	2.8	<u>2.1</u>	18
M	Isotopes	1.2	<u>1.0</u>	33	4.7	<u>3.7</u>	31
N	Chem. Tech.	0.8	<u>0.7</u>	23	7.3	<u>3.6</u>	30

Note: Table 5.1 includes a breakdown of exposures for employees where a dose exceeds approximately 1/3 of the MPE as follows: (1) employees whose quarterly dose exceeded 3.0 rem for the skin of the whole body (D_s) or 1.0 rem for the total body (D_c), and/or (2) employees whose dose for the year to date exceeds a D_s of 10.0 rem or a D_c of 4.0 rem.

Table 5.2 Concentration of Radioactive Materials in Air Averaged Weekly from Filter Paper Data—3rd Quarter, 1962

Week No	LAM Network ^a	PAM Network ^b	RAM Network ^c
27	$2.0 \times 10^{-12} \mu\text{c/cc}$	$1.8 \times 10^{-12} \mu\text{c/cc}$	$1.8 \times 10^{-12} \mu\text{c/cc}$
28	4.2	3.7	4.2
29	3.6	3.6	3.6
30	2.0	2.0	2.2
31	1.6	1.5	1.7
32	2.2	2.0	2.3
33	2.4	1.9	2.2
34	1.7	1.5	1.9
35	4.1	3.6	3.6
36	1.2	1.3	2.4
37	1.7	1.6	1.9
38	4.7	4.4	5.8
39	2.6	2.3	3.8
Quarterly Average	$2.6 \times 10^{-12} \mu\text{c/cc}$	$2.4 \times 10^{-12} \mu\text{c/cc}$	$2.9 \times 10^{-12} \mu\text{c/cc}$
Year to date Average	$3.7 \times 10^{-12} \mu\text{c/cc}$	$3.5 \times 10^{-12} \mu\text{c/cc}$	$4.2 \times 10^{-12} \mu\text{c/cc}$

^aLAM - Local Air Monitor located at or near the X-10 site.

^bPAM - Perimeter Air Monitor located on the outer boundary of AEC-controlled area.

^cRAM - Remote Air Monitor located from 12 to 75 miles from ORNL.

Table 5.3 Radioparticulate Fall-Out Measurements Averaged
Weekly from Gummed Paper Data—3rd Quarter, 1962

Week No	IAM Network	PAM Network	RAM Network
27	72 particles/ft ²	53 particles/ft ²	52 particles/ft ²
28	8	6	7
29	13	6	9
30	48	19	22
31	13	13	11
32	32	27	36
33	8	9	5
34	9	5	8
35	28	22	9
36	12	14	13
37	22	28	17
38	24	18	19
39	32	23	35
Quarterly Average	25 particles/ft ² /wk	19 particles/ft ² /wk	19 particles/ft ² /wk
Year to date Average	39 particles/ft ² /wk	26 particles/ft ² /wk	22 particles/ft ² /wk

Table 5.4 Concentration of Radioactive Materials in Rain Water
Averaged for the Quarter by Stations—3rd Quarter, 1962

<u>Station Number</u>	<u>Location</u>	<u>Concentration</u>
<u>LAM Network</u>		
HP-7	West of 7001	$0.8 \times 10^{-6} \mu\text{c/ml}$
<u>PAM Network</u>		
HP-31	Kerr Hollow Gate	$0.8 \times 10^{-6} \mu\text{c/ml}$
HP-32	Midway Gate	0.4
HP-33	Gallaher Gate	0.6
HP-34	White Oak Dam	0.5
HP-35	Blair Gate	0.6
HP-36	Turnpike Gate	0.7
HP-37	Hickory Creek Bend	0.6
Network Average		$0.7 \times 10^{-6} \mu\text{c/ml}$
<u>PAM Network</u>		
HP-51	Norris Dam	$0.9 \times 10^{-6} \mu\text{c/ml}$
HP-52	Loudoun Dam	0.2
HP-53	Douglas Dam	0.7
HP-54	Cherokee Dam	0.4
HP-55	Watts Bar Dam	0.4
HP-56	Great Falls	0.8
HP-57	Dale Hollow	0.6
Network Average		$0.6 \times 10^{-6} \mu\text{c/ml}$

Table 5.5 Radionuclides in White Oak Lake Effluent—
3rd Quarter, 1962

Isotope	% of Total Beta Radioactivity		
	July	August	September
Ru ¹⁰⁶	94.76	87.23	91.88
Zr ⁹⁵	0.08	0.08	0.05
Tre-Ce*	0.96	4.09	1.28
Cs ¹³⁷	1.07	2.28	1.40
I ¹³¹	0.02	0.004	0.44
Ce ¹⁴⁴	0.13	0.47	0.16
Nb ¹⁹⁵	0.55	0.04	0.12
Ba ¹⁴⁰	0.05	0.04	0.02
Co ⁶⁰	1.17	1.26	3.15
Sr ⁸⁹	0.13	0.47	0.16
Sr ⁹⁰	1.09	4.05	1.38
Total Beta Curies Discharged	100	19	64

* Total Rare Earths Minus Cerium

Table 5.6 Average Concentration of Radioactive Materials in the Clinch River at Mile 20.8—3rd Quarter, 1962

Month	Radionuclides of Primary Concern (10^{-8} $\mu\text{c/ml}$)					Gross Beta (10^{-6} $\mu\text{c/ml}$)	(MPC) _w ^b (10^{-6} $\mu\text{c/ml}$)	%
	⁹⁰ Sr	¹⁴⁴ Ce	¹³⁷ Cs	¹⁰³⁻¹⁰⁶ Ru	⁶⁰ Co			
July	0.15	0.02	0.15	13	0.16	0.29	4.7	6.3
August	0.14	0.03	0.08	3.0	0.04	0.04	2.1	1.9
September	0.14	0.02	0.14	9.1	0.31	0.24	4.4	5.4

^aConcentrations at Mile 20.8 are calculated using the dilution factor afforded by the river and the observed concentrations in White Oak Lake effluent.

^bWeighted average (MPC)_w for populations in the neighborhood of a controlled area calculated for the mixture using (MPC)_w values for specific radionuclides recommended in NBS Handbook 69.

Table 5.7 Average Concentration^a of Radioactive Materials in Clinch River Water at ORGDP Filtration Plant Intake—3rd Quarter, 1962

Month	Radionuclides of Primary Concern (10 ⁻⁸ μ c/ml)		Gross Beta	(MPC) _w ^b	%
	Sr ⁸⁹⁻⁹⁰	Ru ¹⁰³⁻¹⁰⁶	(10 ⁻⁶ μ c/ml)	(10 ⁻⁶ μ c/ml)	(MPC) _w ^b
July	0.68	27	0.26	2.8	9.3
August	0.41	4.7	0.05	1.2	4.0
September	0.32	7.9	0.09	2.5	3.8

^aObserved values based on analyses of weekly composited samples.

^bWeighted average (MPC)_w for populations in the vicinity of a controlled area calculated for the mixture using (MPC)_w values for specific radionuclides recommended in NBS Handbook 69.

^cDue to the relocation of sampling equipment, one sample was collected during the week ending September 23, 1962.

Table 5.8 Background Measurements of Ionizing Radiation—3rd Quarter, 1962

Area	Monthly Average for All Stations (mr/hr)			Quarterly Average for		Year to Date Average
	July	August	September	All Stations (mr/hr)	All Stations (mr/hr)	
Laboratory Site (53 Stations)	0.110	0.140	0.105	0.118		0.100
Off-Site (5 Stations)	0.025	0.035	0.026	0.028		0.029

Note: The background in the Oak Ridge area in 1943 was determined to be approximately 0.012 mr/hr.

6.0 FIGURES

	<u>Page</u>
6.1 Concentration of Radioactive Materials in Air (Filter Paper Data).....	24
6.2 Radioparticulate Fall-Out Measurements (Measured by Autoradiographic Techniques Using Gummed Paper Collectors).....	25
6.3 Concentration of Radioactive Materials in Rain Water.....	26
6.4 Radioactive Content of Clinch River Water.....	27
6.5 Background Measurements of Ionizing Radiation.....	28

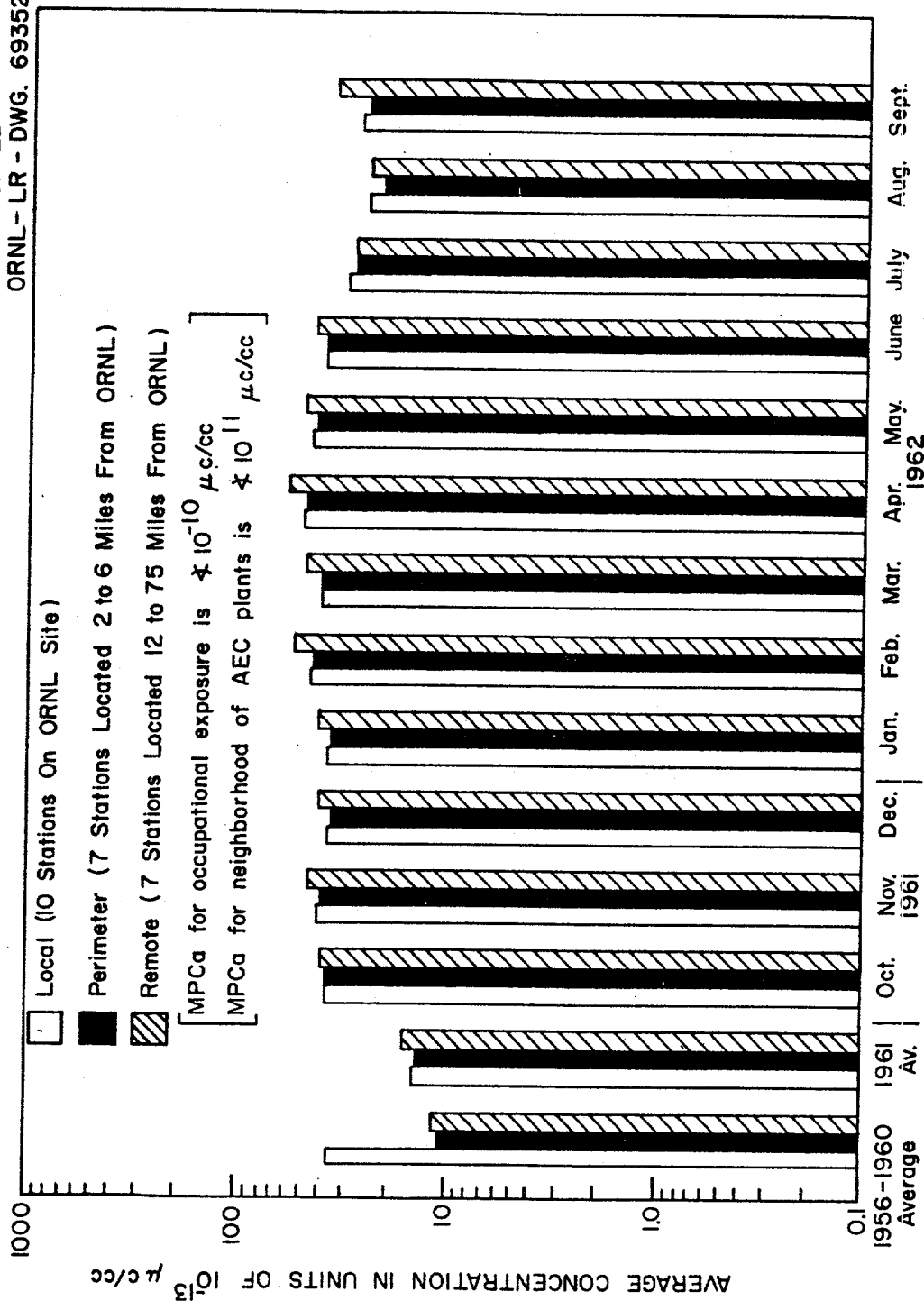


Fig. 6.1 Concentration Of Radioactive Materials in Air
(Filter Paper Data)

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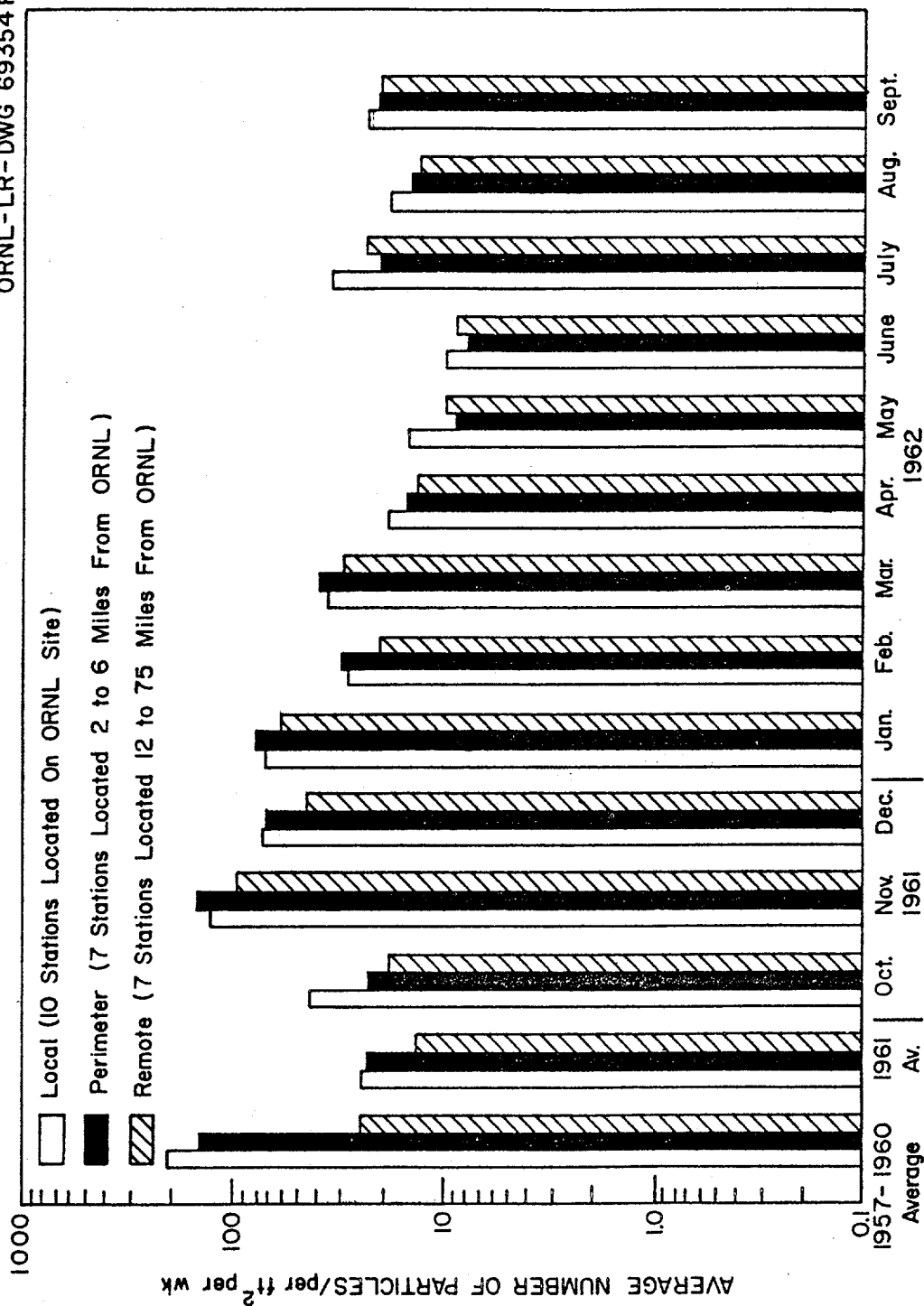


Fig. 6.2 Radioparticulate Fall-Out Measurements
(Measured By Autoradiographic Techniques
Using Gummed Paper Collectors)

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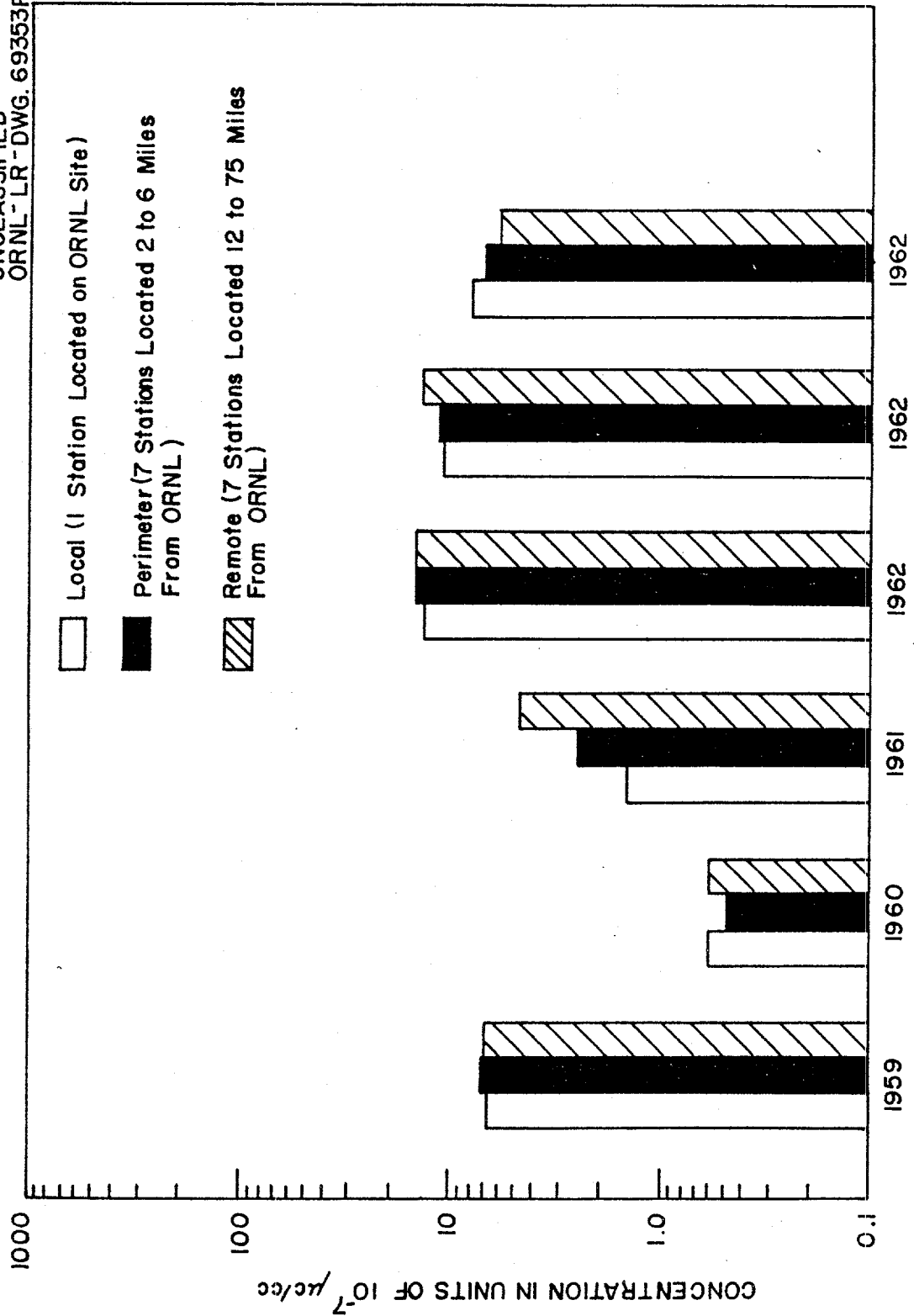


Fig 6.3 Concentration Of Radioactive Materials In Rain Water
(1ST QTR) (2ND QTR) (3RD QTR)

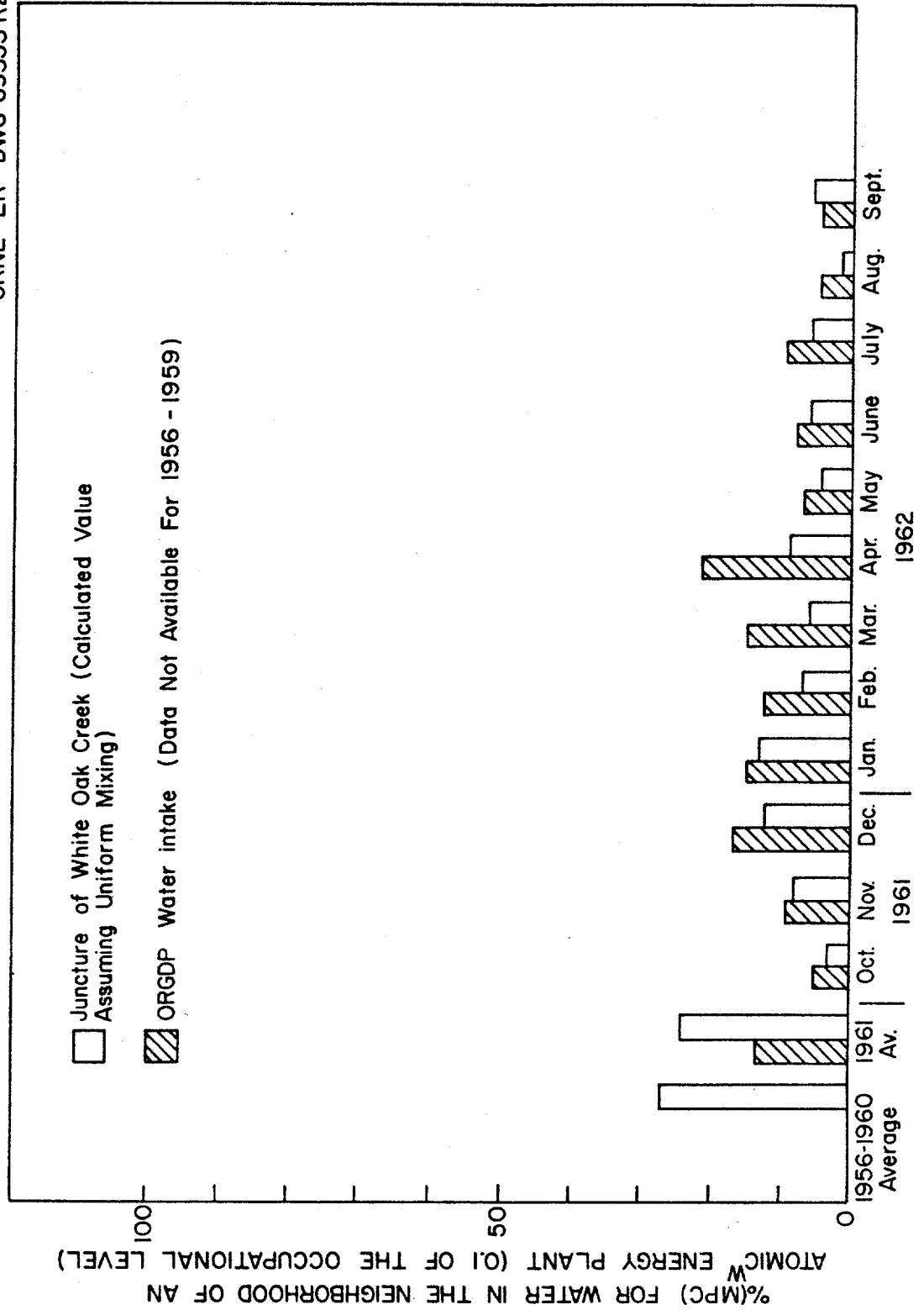


Fig. 6.4 Radioactive Content Of Clinch River Water

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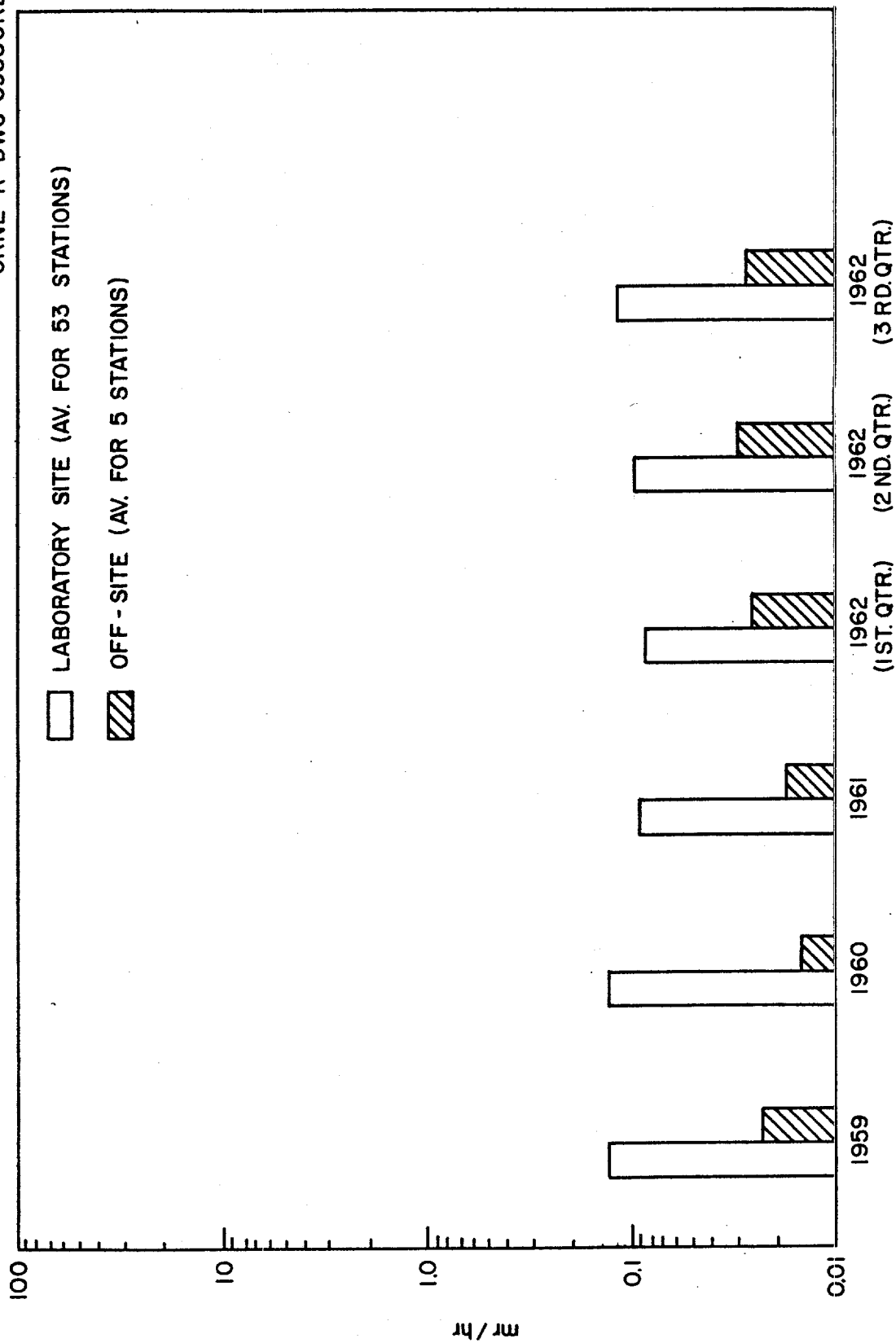


Fig. 6.5 Background Measurements Of Ionizing Radiation

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